

PROCESS FOR FORMING ARTIFICIAL IMPLANTS

BACKGROUND OF THE INVENTION

For many years, the medical profession, with limited success, has endeavored to repair shattered or diseased bones or replace shattered sections of bones in the human anatomy by replacing such bones with suitable substitutes, usually of an animal nature, such as live bones obtained from sheep. Such technique obviously has great limitations because of the dissimilarity of any substantial portions of such bones in an animal to those in a human anatomy. Under some circumstances, particularly to insure affinity, and thus acceptance, of one human bone or group of bones by another, a further well-known technique has been to remove a section of a bone from one portion of a human anatomy and graft it to bones in another portion of the anatomy. Specifically, spinal vertebrae have been welded or fused in this manner by using a section of a leg bone of the same person and grafting it to selected vertebrae. This technique also has certain limitations of use for purposes of replacing or repairing certain bones in the human anatomy.

In relatively recent years, it has been found that the human anatomy will accept implants or replacement portions or sections formed from nonhuman substances, such as metals and certain ceramic items to which human tissues tend to adhere in order to restore natural muscular action as much as possible. Certain mechanical connections have been resorted to between the synthetic items and the natural bones or tissues with which they are associated. In this regard, the repair or strengthening of shattered, weakened, diseased or broken bones by the use of metal pins or plates are well known. In regard to the use of metal for such purposes, however, it also is well known that extreme caution has to be exercised to prevent the occurrence of infection as well as the prevention of corrosion of the metal by the reaction therewith of human body fluids.

The foregoing activities not only have been undertaken with respect to bones of the anatomy, but also in regard to forming artificial implants in the shape of the root or roots of teeth which are inserted in the socket from which a natural tooth has been extracted. Where suitable aseptic conditions are observed and practiced, cases are known where such procedures have been acceptable for purposes of providing either an entire artificial tooth upon which an artificial root implant is integrally formed or such artificial root-shaped implant is provided with a suitable support base for an artificial crown or the like. Examples of this latter procedure comprise the subject matter of the following U.S. Pat.:

No. 448,745	Wright	1891	Cl. 32-8
No. 470,332	Friel	1892	Cl. 32-8
No. 943,118	Greenfield	1909	Cl. 32-9
No. 2,745,180	Kiernan, Jr.	1956	Cl. 32-10
No. 2,857,670	Kiernan, Jr.	1958	Cl. 32-10

In all of the foregoing situations referred to above, the repair element or replacement part or section, whether used with respect to bones of the human anatomy or to replace extracted human teeth, the replacement part or implant has required preparation, or prosthesis, prior to surgery incident to installing or implanting the artificial element or section within the human anatomy. Particularly where the shape of the artificial part or section is desired to be as close as possible to that of the natural bone or tooth, for example, which it is to replace, it is obvious that considerable difficulty is experienced incident to the preparation of prosthesis of such artificial replacement part or section for immediate use during surgical operations.

In order to achieve the desired shape as closely as possible by current techniques, X-ray radiographs taken from various angles are used as a basis for determining the accurate shape and dimensions, where this technique is applicable. In regard to forming artificial root implants for substitution of the roots of natural teeth, the foregoing patents disclose the technique

of forming a suitable approximate shape and relying upon the pliability of natural tissues and especially the periodontal membrane to accommodate any difference in shape of the artificial root over that of the natural root which was extracted.

Further, in view of the fact that metal and ceramic materials have been used to form the aforementioned artificial substitute members, parts or sections for replacement of the equivalent natural portions or parts of hard tissue elements of a human anatomy, it is obvious that such substitute elements cannot be formed in the very short period of time which usually is necessary to insure biological acceptance of the artificial member by the adjacent human tissues or other parts of the human anatomy. For example, it is known that if the periodontal membrane, which defines the socket from which the root of a natural tooth has just been extracted, is exposed for over 40 minutes, the probability of said membrane ultimately adhering in a natural manner to a root implant formed from nonhuman material practically is nil. It is obvious, therefore, under the circumstances, that the formation of an artificial replacement part or section of a vertebrate anatomy by the technique of directly using the natural member as a model, forming a mold therefrom, using the mold to form the artificial replacement member, such as by pouring molten metal thereto or molding a ceramic member and then firing it, coupled with suitable finishing operations, cannot be accomplished within the relatively short period of time which nature dictates to be the acceptable period as described above.

In very recent times, experiments performed on certain animals, especially monkeys, appear to confirm the feasibility of making replacement parts and sections of bones from ceramic materials, firing the molded parts, and implanting the same within the animal tissues for the adherence of such tissues thereto in a natural manner. However, such replacement parts must be molded, fired, and otherwise completed prior to surgery in order to accomplish this. Accordingly, such artificial members must be made solely upon reliance of shapes disclosed by X-ray radiographs due to the length of time required to completely form the artificial member in finished condition.

SUMMARY OF THE INVENTION

It is the principal object of the present invention to provide a process as well as apparatus for performing the same by which substantially precisely exact copies or reproductions of natural hard tissue elements such as bone parts, members and sections may be formed from synthetic materials and particularly various suitable types of synthetic resin materials or plastics, said process requiring no preparation or prosthesis prior to surgery. X-ray radiographs may be resorted to in order to detect the location of damaged or diseased bone, teeth or the like, but such radiographs need not be employed in any manner to facilitate the formation of the artificial parts, members or sections to be implanted in the body of the vertebrate, as has been necessary heretofore.

It is another object of the invention to provide in such process the step of removing or extracting the natural hard tissue part, member or section from the vertebrate anatomy incident to surgery being performed, use said removed or extracted hard tissue element, after quickly and suitably debriding the same, to form a mold from quick-setting elastic material, using said mold to form a replacement element from suitable synthetic resin material by any one of a number of known techniques, and after quick-curing of the artificial element, the same is extracted from the mold with the result that it is a faithful reproduction of the shape of the natural element it is to replace. Thus, there is a minimum disturbance of natural tissues and material in the locality of the anatomy in which the artificial member is to be inserted and implanted, this being particularly important in the formation of tooth implants in humans for acceptance by the periodontal membrane which will adhere to the artificial element by natural growth, such growth being assured by the entire procedure consuming less time than the very restrictive period permitted by the natural